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Sustainable Agriculture and the Environment:
The Gambia Case Study

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Sustainable Agriculture and the Environment:

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This Working Paper is one of a number of case studies prepared for CDIE's assessment of USAID Sustainable Agriculture and the Environment programs. As an interim report, it provides the data from which the assessment synthesis is drawn. Working Papers are not formally published and distributed, but interested readers can obtain a copy from the DISC.

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PREFACE

A.I.D.'s Center for Development Information and Evaluation (CDIE) is conducting a worldwide assessment of its environmental programs. Initially, the assessment is focusing on the environmental impact of A.I.D.-supported programs in two areas: sustainable agriculture and forestry. Other environmental areas may be covered in subsequent assessments.

This assessment on sustainable agriculture in The Gambia is one of five country case studies. Similar studies have been completed for the Philippines, Mali, and Nepal, and a study is planned for Guatemala. The results of the five case studies, all of which follow a similar analytical framework, will be synthesized into an overall assessment that summarizes lessons learned from a worldwide perspective and highlights the program and management implications for A.I.D.

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The evaluation team received excellent support from numerous individuals in The Gambia and from USAID/Banjul during the course of the assessment. The team is particularly grateful for the assistance provided by its four Gambian counterparts-cum-researchers: Kabir Sonko, Isatou Sawaneh, Musa Suso, and Kotu Bojang.

SUMMARY

The vast majority of The Gambia's population depends directly on the country's natural resource base for food, energy, and income. However, the natural resource base has been weakened and degraded over time as a result of population growth and a decline in rainfall.

A.I.D. has supported sustainable agricultural development in The Gambia since the late 1970s. This support was provided primarily under three projects: the 13 year, $4.960 million Soil and Water Management (SWM) project that began in 1978 and ended in 1991; the $9 million Mixed Farming and Resource Management project (MFP) which began in 1979 and ended in 1986; and the $16.3 million Gambia Agricultural Research and Diversification (GARD) project which began in 1986 and ended in 1992.

A four person team conducted an assessment of the environmental impact of A.I.D.'s support to sustainable agriculture in The Gambia during a four week period in October 1993, 15 years after A.I.D. support had begun in 1978.

The team based its findings on a careful review of existing documentation, especially past evaluations; structured interviews with persons and organizations in The Gambia knowledgeable about A.I.D.-supported programs in sustainable agriculture; and perhaps most important, visits to ten sites in all five administrative regions of The Gambia to assess impact from the perspective of the intended beneficiaries.

The results of the A.I.D.-supported activities are indeed quite dramatic. The construction of saltwater intrusion dikes in the lowlands and contour berms in the uplands -- the principal technologies introduced by A.I.D. -- had significant biophysical and socio-economic impacts. They rehabilitated and protected saline soils in the lowland swamps, and they protected soils from erosion on the upland slopes. As a result, saline soils could be cultivated again; crop yields, particularly of swamp rice, increased significantly (oftentimes doubling in the first year); water tables rose; and soil and gully erosion was reduced. Because women are typically the rice growers in The Gambia, women were among the major beneficiaries of the activity.

During the nine year period 1983/84 through 1992/93, the Soil and Water Management Unit (SWMU), which had been created by A.I.D., rehabilitated 1,611 hectares of land planted to lowland rice; this equals about 15 percent of total lowland rice area in The Gambia. During the same period, upland conservation structures were installed on 1,920 hectares, nearly all of which is planted to maize, millet, grain sorghum, and groundnuts; this represents about 1.3 percent of the total land planted to these upland

crops.

The economic impact of the soil and water conservation technologies is impressive. Within one to two seasons, average rice yields increased by 108 percent, from 1.3 to 2.7 tons per hectare. Many rice farmers confirmed that yields on significant portions of their swamp rice land had increased from virtually zero to one to two tons per hectare within one season. In one village, women confirmed that they were able to harvest from one plot what they typically harvested from three plots before the saltwater intrusion dike was constructed. In Njawara, rice was harvested on plots that had not been cultivated for over a decade. In upland areas, the construction of contour berms and other water retention and anti-erosion measures resulted in increased production of millet, sorghum, corn, and peanuts.

Increased production contributed to increased incomes. An improved maize variety was promoted and widely adopted, and this became a new cash crop for farmers. Likewise, crop residues such as groundnut hay and corn stalks were promoted for the purpose of ram fattening, and this helped to increase farmer incomes. Finally, the increased water retention resulting from conservation infrastructure allowed women to raise vegetables as cash crops during the dry season following the rice harvest.

Increased production also contributed to improved food security. Respondents at all sites where saltwater intrusion barriers had been constructed uniformly confirmed that the increased food that was produced was consumed within the household. Both men and women repeatedly pointed out that the saltwater intrusion barriers allowed the family to eat for months without being obliged to purchase rice or other food stuffs. The money saved could then be used for other needs. Improved range management and the practice of feeding crop residues to animals served to diversify production activities, thereby improving food security by spreading the risk across a larger number of food and income generating activities.

There were social benefits as well as economic benefits. The combination of contour berms, reinforced roadways, and grass waterways effectively ended flooding in the village of Njawara. Also, women regained control over subsistence production in their traditional fields, and women were the primary beneficiaries of the new income-earning activities such as vegetable production and ram fattening.

The success and accomplishments of the soil and water conservation activities can be attributed to four main factors. First, the technologies that were introduced produced significant benefits in a relatively short period of time, and this contributed to high adoption rates. Second, the demand for the new technologies originated with the intended beneficiaries:

they, not the donors or the government, determined what was needed, and they backed up this demand by volunteering their labor to construct the dikes and other conservation structures. Third, SWMU, which had been created and continuously supported by A.I.D. year after year for 13 years, developed into a strong institution that provided sound technical advice. Fourth, the new technologies were simple to implement, relatively easy to maintain, placed only minimal demands on additional labor, and required few changes in farmers' existing cropping practices.

Thus, the success of the soil and water conservation activities is very much linked to the introduction of sound technologies and the support of strong institutions. Awareness and education appeared to play a less important role, although various activities had been supported to promote awareness of the importance of soil conservation at both the village and national levels. Similarly, the economic policy environment, which changed substantially over the 15 year period, appeared to have a neutral effect, largely because rice is a subsistence crop and the incremental rice production was consumed domestically and was not sold on the market.

SWMU developed into a strong institution partly because A.I.D. recruited competent and committed technical advisors during the critical early phases of its establishment and partly because A.I.D. supported a strong training component, not only for SWMU but for all activities in the area of sustainable agriculture. By far the majority of those trained under the SWM project returned to apply their skills in their departments of origin. Of the 19 Gambians who received degree and diploma level training, 15 were still working with SWMU in 1988, three had been seconded to other agriculture divisions, and one had retired. Since 1988, eight additional Gambians have been trained under the SWM project, of whom four are working with SWMU and four are working in other agricultural divisions. Similarly, the majority of Gambians trained under the MFP and GARD projects occupied senior public service positions in their areas of specialization, or were actively applying their skills in the private sector or with NGOs.

There remains, however, a critical shortage of management skills on the part of senior and mid-level Gambian officials. Although training in technical fields is crucial, staff with skills in management and administration are also needed.

A.I.D. also sought to encourage the participation of <u>local</u> institutions and populations in sustainable agriculture activities. As the two cases below illustrate, the linkage -- or lack thereof -- between peoples' participation in a common effort and the benefit that is derived from such participation was a critical factor in explaining the success -- of lack thereof -- of the program.

In the case of the SWM project, local communities decided at the outset to distribute benefits in an equitable manner among all participants. In effect, each adult woman received at least one plot of land for swamp rice cultivation in the area reclaimed by the infrastructure; this meant that <u>every</u> family would benefit, including all those within the domestic household, and that no groups or individuals would be "losers." Thus, there was a clear linkage between participation and benefits. However, participation was greater in constructing the saltwater intrusion barriers compared to the contour berms, probably because the benefits were greater, and quicker, for the former compared to the latter.

A very different experience occurred in the case of MFP under which improved grazing plots were established to test improved forage and grass varieties. In contrast to the SWM project, the demand for the range management activity came from outside the population that was to benefit; little actual contribution was required or expected of those who were to benefit; and access to the common resource (and thus to its benefits) was not controlled. As a result, livestock numbers quickly exceeded the carrying capacity of the small trial plots, overgrazing occurred, and despite recognition by the Livestock Owners Association and its members that the test varieties would provide good dry season pasture, no attempt was made to spread their use.

The sustainable agriculture program in The Gambia was generally effective, efficient, and sustainable, and, to a large extent, replicable. Generally speaking, a program can be judged effective if it reaches the population it intends to benefit; if all who can benefit from the activity have an equal opportunity to do so without undue restriction; and if the results are generally those that were anticipated and desired in the design of the activity. On all three counts, the soil and water conservation activities supported by A.I.D. were effective.

In large measure, the high degree of effectiveness was due to: (a) the selection of comparatively simple, low-cost, and easy-to-maintain technologies; (b) the direct and almost immediate linkage between the problem and the proposed solution; that is, the loss of productivity due to saltwater intrusion and the construction of a saltwater barrier; (c) the ability to demonstrate significant, short-term benefits to those participating in the activity; and (d) the willingness of community members to redistribute reclaimed and new lands brought into production on an equitable basis.

In 1991 the U.S. Soil Conservation Service carried out an economic analysis of the soil and water conservation activities in The Gambia. During the 13 year project period, 1978-1991, the benefit-cost ratio was 0.76: benefits were less than costs, indicating that the project was not economically viable over that time period. When the period of analysis excludes the donor phase (treating those expenditures as sunk costs) and instead includes only the 14 year period from 1992 to 2006 (the break-even year), the benefit cost ratio is 5.18: each dollar expended returns over 5 dollars, which is a very attractive rate of return.

A.I.D., through SWMU, funded the initial soil and topographic surveys and design work required to construct saltwater intrusion dams. A tractor was also provided to loosen the soil used to construct the dikes and to transport stones and cement used to construct small spillways. These initial costs are substantial and probably not amenable to recovery from poor rural villagers. Therefore, the program will probably never be financially self-sustainable in the sense that these initial costs will be completely borne by the beneficiaries.

As far as future construction is concerned, the sustainability of the program will depend on whether or not resources are made available by the government (or a donor) to finance these substantial up-front cash costs. It is also possible, however, that the villagers themselves may be able to cover a portion of these costs. There certainly appears to be a willingness to do so in view of the fact that the saltwater intrusion dams and other infrastructure that have been constructed with A.I.D. assistance have, to date, been well maintained by the beneficiaries.

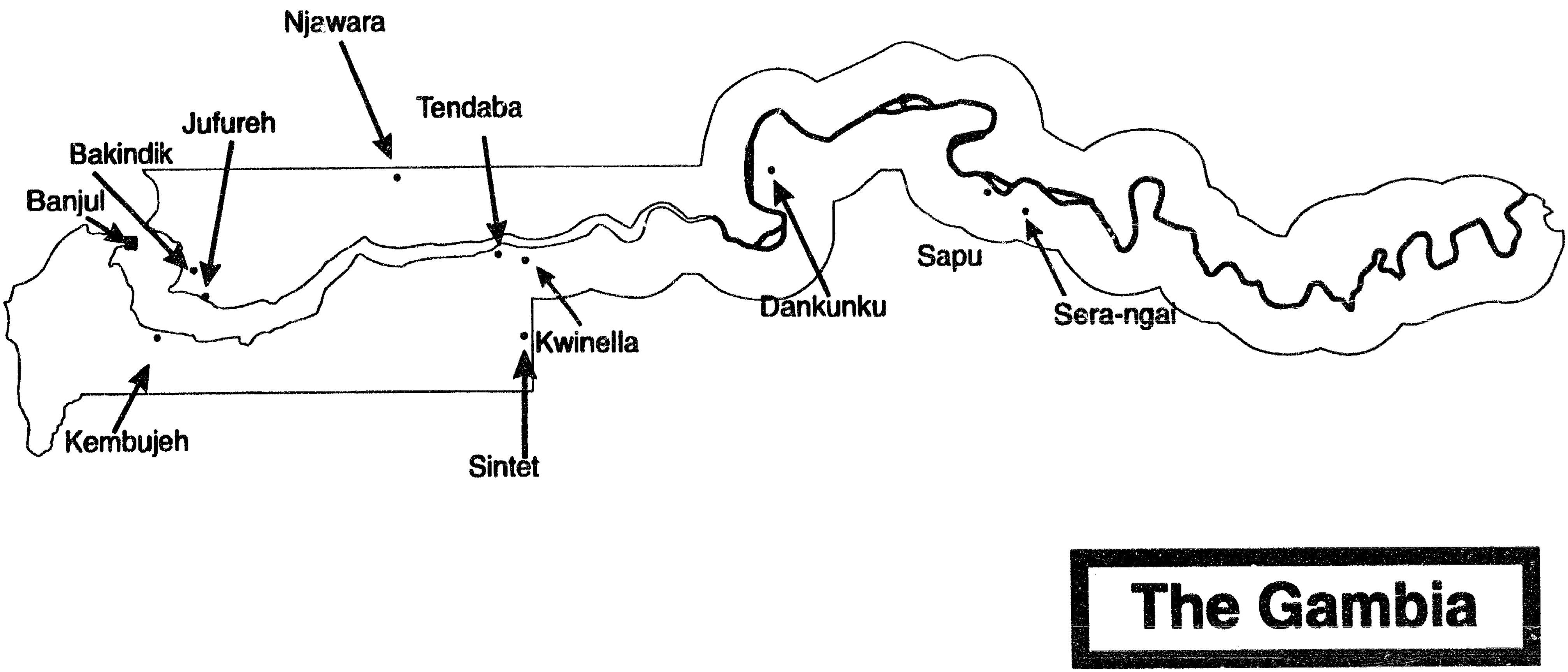
A.I.D.'s efforts at strengthening Gambian technical services have been very successful in terms of the quality of technical personnel and overall performance. SWMU, in particular, represents one of the more productive, technically capable, and dedicated services one is likely to encounter in Africa. However, the long-term sustainability of this and other institutions requires adequate budgetary support from the GOTG or other sources to assure continued operation. Moreover, the retention of trained personnel in the absence of a competitive salary structure will be difficult.

Soil and water conservation concepts, implementation procedures, and maintenance are replicable within rural communities, but the design of conservation structures requires technical expertise that cannot be found among the beneficiary populations. The complex nature of the design of saltwater intrusion dikes and retention dams places a premium on having a well-trained group of professionals, such as SWMU, available to design the structures and to supervise their construction. Also, in the early phases of implementation the technology requires substantial up-front costs. Therefore, the technology can be replicated, but only if resources are available to finance the front-end cash outlays and to fund the cadre of trained professionals needed for the design and supervisory work.

GLOSSARY

A.I.D.	Agency for International Development
Alkalo	Village chief
Alkalolu	Village council
ANR	Agriculture and Natural Resources Project
Bolong	Tributary of a saline tidal estuary
CDIE	Center for Development Information and Evaluation
CRMA	Community Resource Management Agreement
CRS	Catholic Relief Services
Dabada	Household
Dalasi	Gambian unit of currency
EFPA	Economic and Financial Policy Analyses Project
FAO	Food and Agriculture Organization
GARD	Gambia Agricultural Research and Diversification Project
GFP	Gambia Forestry Project
GOTG	Government of The Gambia
GPMB	Gambia Produce Marketing Board
GTZ	German Technical Assistance Agency
IRG	International Resources Group
Kafo	Village work group
LOA	Livestock Owners Association
LTC	Land Tenure Center
MFP	Mixed Farming and Resource Management Project
MOA	Ministry of Agriculture
NCB	Improved maize variety
NGO	Non-governmental Organization
PAAD	Program Assistance Approval Document
PBS	Program Budgeting System
SCS	Soil Conservation Service
Stook	To stack maize stocks
Stover	Maize stalks
SWM	Soil and Water Management Project
SWMU	Soil and Water Management Unit
UNDP	United Nations Development Program
USAID	United States Agency for International Development

Sites Visited by the Evaluation Team



I. INTRODUCTION

In 1992 A.I.D. launched a new 10 year, $22.5 million Agricultural and Natural Resources (ANR) project. The Program Assistance Approval Document (PAAD) for that project describes a Gambian environment in 1992 that is strikingly similar to that which existed in 1978, 14 years earlier, when A.I.D. launched its initial efforts to reverse the trend of environmental degradation. Not only is the agricultural environment of 1992 similar to that of 1978, but also the twin problems that cause that unsustainable trend remain the same, or are worse: rapid population growth and drought.

The vast majority of The Gambia's population depends directly on the country's natural resource base for food, energy, and income. However, the natural resource base has been weakened and degraded as a result of population growth (reported in the 1992 PAAD as 3.4 percent annually and revised in the 1993 decennial Census to 4.1 percent annually) and a decline in rainfall.

The Gambia's population, even if it were growing at the 3.4 percent rate, would double in approximately 21 years, and the country's population density (80 persons per square kilometer) is already one of the highest in Africa. The length of the rainy season and total rainfall have been declining in The Gambia. Rainfall records for the Banjul area indicate that, for the period 1886 to 1968, 50 percent of the years were wet and 25 percent were dry. In contrast, during the period 1968 to 1990, 5 percent of the years were wet and 75 percent were dry.

Traditional resource management practices in The Gambia have not been effectively adapted to these two long-term trends. The result has been environmental degradation which has had direct adverse economic consequences:

- The decline in rainfall has allowed saltwater to intrude more extensively into the Gambia River valley, and the resulting salinization of floodplain rice paddies has reduced the available land on which to grow rice.

- Deforestation has resulted in increased rainfall runoff, soil erosion, loss of biodiversity, and reduced soil fertility.

- Soil erosion and reduced soil fertility have led to decreased crop yields and to expansion of crop area at the expense of the livestock sector.

- Overgrazing and the displacement of livestock onto marginal lands have resulted in rangeland degradation as well as poor animal nutrition and lower milk and meat production.

A.I.D. has supported the development of The Gambia's natural resource base, both in agriculture and forestry, since the late 1970s.

- In agriculture, A.I.D.'s support was provided primarily under three projects: the 13 year, $4.960 million Soil and Water Management (SWM) project that began in 1978 and ended in 1991; the $9 million Mixed Farming and Resource Management Project (MFP) which began in 1979 and ended in 1986; and the $16.3 million Gambia Agricultural Research and Diversification (GARD) project which began in 1986 and ended in 1992.

- In forestry, A.I.D.'s support was provided primarily under the $1.575 million Gambia Forestry Project (GFP) which also began in 1979 and ended in 1986.

In October 1993, 15 years after the first of these activities was initiated, a four-person team visited The Gambia to assess the environmental impact of A.I.D.'s support of sustainable agriculture and forestry. The team was comprised of two economists, one of whom focused on the forestry sector; an agronomist who focused on the sustainable agriculture sector; and a social scientist who covered both sectors. The results are summarized in two reports, this one on sustainable agriculture and a companion report on forestry.

II. BACKGROUND

A. Degradation of Cultivated Lands in The Gambia

Land degradation in the Gambia, as in much of the wet-dry tropics of West Africa, has come about because of increases in human and animal populations. For example: devegetation is caused by increased need for wood for fuel and building materials; reduction in biomass and vegetative cover on rangelands is caused by increased grazing pressure from larger herds of cattle, sheep, and goats; and increased soil erosion, loss of soil organic matter, and decreased soil fertility is caused by shorter or non-existent fallow periods and improper farming techniques on cultivated land. These are all factors which have resulted in degradation of The Gambia's watersheds.

These agents of degradation have resulted in increases in rainfall runoff and soil erosion on the sandy, sloping lands of The Gambia's uplands. Accelerated soil erosion occurs mostly on lands under continuous cultivation of row crops, and especially where farmers plough up and down the slopes instead of on the contour. These improper plowing techniques, when combined with the loss of soil fertility and soil organic matter which result from reduction or elimination of soil restoring fallow periods, have resulted in significant degradation of upland soils on cultivated lands throughout The Gambia. Gully erosion is present in 8 percent of fields cropped to groundnuts and 6 percent of fields planted to cereals (DeCosse, 1992).

Upland moisture is the source of fresh water in the lowland swamps. Most of the fresh water that feeds the lowlands where Gambian women grow swamp rice comes from the rainfall that infiltrates the soil and percolates down to the underground water table. This underground water is the source of the village water in wells as well as the fresh water which supplies the lowland swamps. When rainfall runoff increases, fresh water moves more rapidly through ephemeral streams and flows into the *bolongs* (the saline tributaries of the Gambia River, which is a tidal estuary) instead of entering the ground to be utilized by the rice crop.

Reduced rainfall and reduced water retention have had a serious effect on agricultural production. Since the Sahelian droughts in the early 1970s the annual rainfall in The Gambia, as in much of the Sahel, has declined by about 25 percent. Reduced rainfall by itself would be a serious problem. But, reduced rainfall and increased water runoff caused by land degradation have combined to diminish the source of fresh water for lowland swamps and to lower water tables in the lands adjacent to the swamps. With less fresh water flowing into the swamps and with lower water tables, the saline water from the estuary and *bolongs* has intruded further inland, oftentimes reducing rice yields. In addition to yield reductions, many communities have experienced significant reductions in their cultivatable area.

B. A.I.D.'s Strategy to Reduce Environmental Degradation

The evaluation team looked carefully at three A.I.D.-funded agricultural projects in The Gambia which were judged to have components related to sustainable agriculture: the SWM project, MFP, and GARD. The team focused on the SWM project because every component was targeted directly toward environmental degradation, whereas the other two projects included many activities which had only indirect environmental impact. However, MFP and GARD were examined as appropriate.

The SWM project had three broad goals (A.I.D., 1988):

- Halt and reverse environmental degradation due to traditional cultivation practices.
- Stabilize and/or increase production of food, forage, wood, and cash crops, and reduce susceptibility to drought and other weather variations.
- Develop the institutional capacity of the GOTG to deliver educational, technical, and material services in soil and water management to the rural population.

The specific purposes of the project as stated in the SWM Project Paper Supplement (A.I.D., 1988) were:

- Establish a Soil and Water Management Unit (SWMU) within the Ministry of Agriculture (MOA).
- Develop technology for improved agricultural and pastoral methods consistent with Gambian abilities and resources.
- Train Gambian soil and water management specialists and agricultural assistants to apply solutions to soil and water problems at national and village levels.

Thus, the principal strategies that A.I.D.'s SWM project used were to develop conservation technologies, strengthen government institutions within The Gambia to carry out conservation activities, and train technicians to assure local capacity. USAID/Banjul's funding for the SWM project was $4.96 million from 1978 to 1991.

The approaches taken to develop and introduce technologies under MFP and GARD were quite different from those of the SWM project. MFP supported a potpourri of activities, including research, agricultural extension, institution building, input supply, farmer surveys, and on-farm demonstration. It worked on a wide range of technologies to cover many different types of farmers and farming systems -- cattle herders and owners, women growing lowland rice for household subsistence needs, men growing groundnuts as a cash crop. GARD, in notable contrast to MFP, focused very narrowly on strengthening agricultural research capacity. The goal of the project was not to develop and promote new technologies to increase production or make agriculture more sustainable, although in several instances the project staff engaged in activities in support of that goal.

III. EVALUATION FINDINGS

The evaluation findings reported below are organized as follows: Part A concerns program implementation; Part B concerns program impact; and Part C concerns program performance.

A. Program Implementation

This section assesses the relative importance of four specific strategies that are typically associated with successful sustainable agriculture programs: (a) technological change; (b) awareness and education; (c) institution building; and (d) the policy environment. In order to assure comparability, the relative importance of each of these four strategies was assessed in the other CDIE-sponsored country studies on sustainable agriculture as well.

1. Technological Change

This section focuses on the technologies and improved practices that were introduced in The Gambia under the SWM project, because it was the longest-running and most comprehensive of the three projects. MFP and GARD are covered at the end of this section, although in less detail than the SWM project.

Soil and Water Management Technologies: How They Work

One of the stated purposes of the SWM project was to "develop technology." Based on a number of existing conservation technologies, the project trained GOTG staff in SWMU to design conservation measures for village watersheds, provided the equipment needed to carry out those designs, and developed ways to make villagers and extension workers aware of these technologies.

SWMU has four technologies which are the key tools it uses to prevent land degradation in The Gambia: (a) salt intrusion dikes; (b) water retention dams; (c) contour berms and contour plowing; and (d) grass waterways. The dams and dikes are used in the rice producing areas along small ephemeral streams that run into the river Gambia as well as in the swamp lands at the mouths of the streams adjacent to the saline estuaries of the river. The contour berms and contour plowing techniques are targeted for upland fields devoted to millet, grain sorghum, corn, peanuts, and other crops. Each technology and what it is designed to do is described below.

Dikes Stop Salt Intrusion in Swamp Rice Lands: The salt water intrusion dikes have proved to be very effective structures to reduce soil degradation in the lowland rice swamps next to the *bolongs*. They stop salt intrusion by impounding the runoff water at the mouth of the small streams flowing into the *bolongs*. This raises the fresh water table in the swamplands farthest from the *bolong* and flushes out the salts and reduces the salinity of the soils closest to the *bolong*.

Village surveys and visits with farmers indicate an immediate change in the first season after salt intrusion dikes are installed (Table 1). The higher water table caused by the dike reduces water stress and helps to increase rice yields in the swamp areas away from the *bolongs*. In the cultivated swamp areas adjacent to the *bolongs*, farmers find that lands taken out of production due to salinization can be cultivated again.

Water Retention Dams in the Lowlands Capture Rainfall Runoff: Increased land degradation, which results in decreased rainfall infiltration and moisture conservation, along with reduced rainfall levels in the last 15 years, have caused water tables to fall in the valley bottoms of small streams in The Gambia. Many of these valley bottoms, which had been used for rainfed (upland) rice production by women villagers for many years, have been marginalized. Rice grain yields are lower, due to lack of moisture, and the risk of crop failure is greater.

Water retention dams help to solve this problem by impounding some of the water that flows into the streams immediately after it rains. This raises the water table which creates some additional areas for flooded rice production closest to the dams and increases moisture availability for rice production further from the dams. Water retention dams do not produce results as dramatic as salt intrusion dikes, because farmers do not benefit from increased land area that results from reclaiming saline soils. Nonetheless, the site visits and surveys indicate that farmers do realize positive benefits from the water retention dams (Table 1, p. 21).

Contour Berms Control Upland Erosion and Rainfall Runoff: SWMU has installed contour berms and promoted contour farming on cultivated upland fields at many sites. These fields, which are plowed and planted every year, are cultivated with millet, groundnuts, grain sorghum, and maize and are very susceptible to soil erosion caused by heavy rains and high runoff. The contour berms, which are mounds about one meter high and two or more meters at the base, run along the topographic contour of the field. They stop water from flowing downslope and allow rainfall runoff that would normally be lost to infiltrate into the soil. The contour farming techniques promoted by SWMU, which are standard conservation recommendations worldwide, consist mainly of plowing and seeding along, rather than up and down, the slope.

Although the labor needed to build the berms is about the same as that needed for dikes (Dikes are somewhat larger than berms, but usually more berms are needed.), farmers do not experience the dramatic increases in yield that they do as a result of salt intrusion dikes and water retention dams. In general, the investment of time and effort to construct contour berms has a long-term payoff and therefore is of less interest to farmers. The exception to this observation occurs in areas where there have been problems with heavy rainfall runoff, severe soil erosion, flooding of villages, and damage to roads following heavy rains. For example, farmers at Njawara were enthusiastic about contour berms because they halted severe gully erosion that contributed to flooding in the village, whereas farmers in Sintet, where flooding was not a problem, saw little benefit from building contour berms (Table 1).

In general, when farmers install a series of contour berms along a slope, not everyone receives the same benefit. Even though everyone on the hillside may work to install berms, usually the farmers at the bottom of the hill benefit the most because they have the most erosion in their fields.

Grass Waterways Prevent Gully Erosion: SWMU has also promoted and installed grass waterways at a number of sites in The Gambia. Grass waterways, which usually are built along with contour berms on upland fields, prevent soil loss and damage to fields by stopping the gully erosion that often accompanies heavy rains. Protecting the waterways usually involves planting grass, which covers the soil and holds it in place. Where gully erosion is severe, it is necessary to build small dams, usually with rocks, to protect against the erosive force of rapidly moving water.

As in the case of contour berms, farmers do not receive an immediate significant benefit from their efforts. Likewise, the benefits are mainly to those farmers who have fields at the lower end of the gully, or those with houses in the flood path. As such, farmers at the upper portion of a waterway are oftentimes less enthusiastic about establishing and maintaining them, and SWMU has not had as much success with their adoption.

Summary: Salt intrusion dikes and water retention dams are generally very effective technologies to reclaim saline soils and to combat lower water tables for areas under both lowland and upland swamp rice production. Most communities found that the structures made it possible to farm land that had fallen out of production due to salinization, low water tables, or reduced rainfall. The results from the structures are quite striking, and SWMU estimates that, within one or two seasons following construction, rice yields increase by 108 percent, from 1.3 to 2.7 tons per hectare. During the evaluation team's field visits, many farmers commented that all or significant portions of their swamp rice land had gone from little or no yield back to yields in the 1 to 2 tons per hectare range within one season.

Although SWMU has not been as successful in promoting upland conservation practices as it has with rehabilitation of saline soils in the lowlands, several communities have implemented upland conservation programs. In some instances, especially where farmers see the value of the contour berms, they have made significant changes in their upland farming practices, most notably the adoption of contour plowing. In other instances, the contour berms have been ignored and farmers continued to plough up and down the slope, thus destroying the contour berms and allowing soil runoff to continue.

There are two key features of the technologies used by the SWM project, especially the salt intrusion dikes and water retention dams, that make them very appropriate and have contributed to their being enthusiastically adopted by farmers. First, the concepts behind the direct effects of the technology (reduced soil salinity and higher water tables) are relatively easy for farmers to understand. In several cases, farmers had tried to build dikes on their own or had seen them elsewhere and understood how they worked. Second, the dikes and dams are easy to maintain. Maintenance does not have to be done very often, and it requires only a shovel and some labor.

Technologies Introduced by the MFP and GARD Projects

As suggested above, the approaches taken to develop and introduce technologies under MFP and GARD were quite different from those of the SWM project. MFP supported a potpourri of activities and worked on a wide range of technologies to cover many different types of farmers and farming systems. This approach is different from that of SWMU, which focused most of its work on contour berms and contour plowing for upland fields and salt intrusion barriers and water retention dams for lowland rice fields.

Because MFP covered so many technologies and cropping systems, it is difficult to find a single technology or farming system where it had a striking success or impact that improved agricultural sustainability. The promotion of improved maize varieties, for which MFP is frequently credited[3], does not increase the sustainability of agriculture, at least not as directly as soil erosion control and the technologies promoted by SWMU. Likewise, supplementary feeding of confined livestock, maize stooking, use of groundnut hay, and composting, which were "already existing" technologies promoted by MFP, either have not been adopted very widely or have not had a very direct effect on the soil and vegetative resource base of The Gambia.

GARD, in contrast to MFP, focused very narrowly on strengthening

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[3]It should be mentioned, however, that the improved maize varieties so widely popularized and disseminated by MFP were developed before MFP was implemented.

agricultural research capacity. The goal of the project was not to develop new technologies to make agriculture more sustainable, although in several instances the project staff engaged in activities in support of that goal. GARD's impact on technology development was to train people and build an institution which would have the capacity to develop and test new technologies, and thus to promote sustainable agriculture in the long-run.

The approaches taken by the MFP and GARD projects make it difficult to attribute the development and dissemination of sustainable agriculture technologies solely to them. However, the evaluation team identified many "concepts and approaches" and "components of technologies" introduced by MFP and GARD which were later more fully developed and used by the government, either alone or in collaboration with other donor-funded projects. For example:

- MFP used a "field orientation" when it worked with farmers which provided a model that subsequent programs adopted.
- Although MFP's efforts at on-farm testing and demonstration were flawed, the concepts of "trying out" new technologies under farmers' conditions and getting their "feedback" produced valuable lessons that were adopted by subsequent projects (most notably the UNDP's Rangeland and Water Development project based in Dankunku).
- The integration of livestock and crop agriculture, so vital to sustainable agriculture, was an important theme introduced by MFP and later developed by GARD, by encouraging and strengthening interdisciplinary research.
- Resource management concepts, especially studies on range burning, were introduced under MFP and GARD and have been included in subsequent work supported by other donors, including the Gambian-German forestry project and the UNDP's diary project.

2. Awareness and Education

National-level Activities: SWMU took various steps to promote awareness of the importance of soil conservation. Its activities included: (a) hosting soil conservation and environmental education conferences; (b) producing supplemental readers on environment and natural resource conservation for primary schools; (c) sponsoring an exhibit at The Gambia National Museum (The museum receives about 16,000 visitors per year.)[1]; (d) developing an informational video describing The Gambia's

[1]Peace Corps volunteers assigned to SWMU assisted with this effort as well as with the production of the primary school materials.

soil and water conservation problems; (e) producing brochures and posters on soil and water conservation and the environment; and (f) presenting lectures on soil and water conservation at Gambia College.

The evaluation team was not able to assess the effect that awareness and education activities had on changing people's attitudes and behavior. However, these and other activities had created a general awareness about SWMU's work. All of the key informants as well as people outside of government, mostly in the urban areas near Banjul, were very familiar with SWMU's work and generally had a favorable opinion.

Community Knowledge of SWMU's Capability: Based on the site visits the evaluation team found that community adoption required: (a) an understanding of the potential of dikes and dams to increase productivity and reduce damage from flooding and soil erosion; and (b) an awareness of SWMU's capacity to provide technical assistance. Most communities learned about the potential of salt intrusion dikes and moisture retention dams through observation of nearby communities and previous experience with dikes and dams on their own lands. Most communities found out about SWMU's capacity to provide technical assistance through SWMU's extension workers. Occasionally, they learned by observing SWMU collaborate with nearby villages or through radio programs on agriculture.

In the case of contour berms, contour farming, and grass waterways, SWMU had to take a more proactive approach. Where villagers requested dikes and dams to improve their lowland rice production, SWMU emphasized the need to control soil erosion and excessive rainfall runoff on uplands in order to get the full benefit of the other structures. Where villages had problems with excessive flooding, it was much easier for SWMU to help farmers become more aware of how upland conservation structures work and what the benefits of building them would be.

3. Institution Building

A.I.D.'s investments in sustainable agriculture in The Gambia have had a net positive effect on the environment and on the sustainable management of natural resources. Experience in The Gambia clearly demonstrates the importance of national and local institutional capabilities in creating the conditions that favor the adoption and replication of practices in sustainable agriculture that in turn lead to positive socio-economic and environmental impacts. A.I.D. has provided critical support for the creation of a governmental technical service responsible for the conservation and sustainable development of The Gambia's soil and water resources as well as the development of a national agricultural research capability. This section discusses institution building at the national and local levels as well as resource and land tenure systems in The Gambia.

National Level Institutional Strengthening

SWMU owes its existence to the joint efforts of A.I.D., the U.S. Soil Conservation Service (SCS), and the GOTG. Created under the SWM project, SWMU benefitted from long-term technical assistance provided by the SCS; extensive training of Gambian specialists, technicians, and field staff; and the provision of needed equipment, machinery, and materials. SWMU was established to halt and reverse the decline in agricultural productivity due to loss of topsoil, increased flooding, and the salinization of soils from salt water intrusion exacerbated by decreased rainfall and drought conditions.

Through the construction and replication of four basic types of conservation structures -- saltwater intrusion barriers, water retention dikes, contour berms, and grass waterways -- SWMU has been able to improve directly nearly 2 percent of the total area under cultivation in The Gambia (Updegraff, p. 7), while amassing strong popular interest in continuing to expand the areas brought under improved soil and water management practices. Indeed, requests for assistance greatly exceed SWMU's capacity to undertake new projects given its present structure, the absence of decentralized field offices, and budgetary constraints.

A.I.D. also played an important role in the development of a national capacity in applied agricultural research. Both MFP and GARD contributed to the development and dissemination of agricultural technologies and practices that have had a lasting effect on Gambian farming systems, while institutionalizing a system for managing agricultural research activities. Among the key contributions of these projects are the broad adoption of improved maize varieties and the elevation of this crop from small-scale production for immediate household consumption to the status of a major cash crop. MFP also made important contributions in the area of integrating livestock and crop production systems, the improvement of range conditions and range management, and the utilization of crop residues, especially maize stover, as dry season fodder.

Technical Assistance: One of the factors contributing to the success of A.I.D.'s support for SWMU was the selection of competent and committed technical advisors during the critical early phases of its establishment. SWMU staff confirm that the presence of a highly experienced, field-oriented, soil and water conservation specialist provided invaluable on-the-job training opportunities while establishing a clear production orientation for the service from the beginning. Gambian specialists returning from degree training in the U.S. were able to apply their new skills and knowledge in a hands-on environment while benefitting from the advice and experience of the senior expatriate technical advisor.

Similarly, technical assistance personnel provided under GARD concentrated their efforts on building a national capability and ensuring the sustainability of their efforts through close collaboration with their Gambian counterparts. While this approach may not yield the same level of tangible outputs as the more traditional approach of a semi-autonomous project with its own staff, resources, and activities (as was done under MFP), the long-term impact on capacity building is generally higher.

Training: A key factor in strengthening institutional capacity is the upgrading of human resource capabilities. A.I.D. has included strong training components in all of its activities in sustainable agriculture. Training has involved the full range of skill development including long-term overseas degree programs, medium-term technical diploma programs, national training through Gambia College, specialized workshops and seminars, and carefully structured on-the-job training with both national and expatriate specialists.

The results overall have been very positive. By far the majority of trainees have returned to apply their new skills in their departments of origin, or in some cases, in related technical services. Of the 19 Gambians receiving degree and diploma level training during the initial phase of the SWM project, 15 of them were still working with SWMU in 1988, three had been seconded to other agricultural divisions or projects, and one had retired from public service after serving as the unit head for over one year following his return from M.S. level training.

The three-year extension granted to the SWM project in 1988 allowed eight Gambians to be sent to the U.S. for B.S. level training. All eight have since returned with their degrees. Four are currently working with SWMU while the other four have been named as Divisional Agricultural Coordinators under the Department of Agricultural Services. As of 1993, all but two of those receiving B.S. level training during the life of the project and one of the diploma-level trainees were still with SWMU or a related government service.

Similarly, the majority of those Gambians trained under MFP and GARD now occupy senior public service positions in their areas of specialization, or are actively applying their skills in the non-governmental and private sectors. Five of the 14 Gambians trained under MFP are working with NGOs (CRS, Freedom from Hunger Campaign), international research centers (International Trypanosomiasis Center), or development projects in The Gambia. Among those who have continued working in the public sector, one has been appointed as the principal planner for the Ministry of Natural Resources, one is the Director of the Sapu Research Station, and another is the head of the Range Unit of the

Department of Livestock Services. Fourteen B.S. degrees and seven M.S. degrees were earned under the GARD project. There were also 75 short-term trainees, and 1,180 in-service trainees. Of the long-term trainees, 79 percent have returned or are expected to return to public service in the MOA (Implementing Policy Change, p. 20).

Management Support: While A.I.D. has invested considerable resources in strengthening technical capabilities, both human and material, it has been less attentive to the importance of management and administrative capabilities. With the exception of the Program Budgeting System (PBS) introduced under GARD[1], A.I.D. and other donor organizations have done little to improve the capacity of senior technical specialists to discharge effectively the often weighty and time consuming administrative tasks that are part of the responsibility of a section or unit head, director, or administrator. Senior Gambian technical specialists confirmed that a major impediment to performance was the lack of personnel trained in office and personnel management. One official strongly recommended that all senior staff, especially section and unit heads, receive specialized training in management. This would lead to improved operation of their organizations while freeing time for the technical specialists to apply their skills in the areas in which they were trained.

The need for management training was recognized in the final evaluation of MFP which stated that "Perhaps more important than these [technical fields], however, the Ministry of Agriculture needs staff at several levels who are trained in management and administration. This skill area deserves the highest priority in the near future" (Fulcher, 1986, p. 56). This is not yet a "lesson learned" by all project design officers throughout the Agency. The ANR project exemplifies the point. Despite clear shortcomings in management capacity in the key ministries and departments involved in agriculture and natural resources management, the ANR project design does not include a capacity building component for management and administration. Instead, the focus is on policy reform which is of value only if the policies are implemented and enforced. The critical shortage of management skills on the part of senior and mid-level Gambian officials may well place the impact of reform in jeopardy.

Local Level Institutional Support

A.I.D.-supported activities have also sought to include and

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[1]The PBS is a management tool used by administrative units to plan, budget, and monitor program expenditures in a more rational manner, thereby allowing for a more effective determination of funding needs and evaluation of the impact of program expenditures.

encourage the participation of local institutions and populations. Local institutions were used to transmit information and to mobilize labor and other resources for carrying out specific activities; however, little attention was given to strengthening institutional capabilities or involving these institutions and local producers in the design, implementation, and monitoring of the activities in which they were to participate.

A critical factor associated with the success of a program is the degree to which those who participate in producing and managing specific goods or activities see themselves as being the principal beneficiaries of the activity. The importance of this linkage (or lack thereof) between participating in an activity and benefiting from such participation is clearly illustrated in The Gambia.

Effective Linkage: The Case of Soil and Water Conservation: Local institutions such as the *alkalolu* or village council, the *kafo* (a traditional association for mobilizing labor used effectively by women and to a lesser extent by men), specialized committees such as the Village Development Committee or Conservation Committee, and traditional authority as represented by the person of the *alkalo* have been involved to varying degrees in sustainable agriculture activities supported by SWMU. The organization of participation took a variety of forms, depending on the specific capabilities and purposes of the local institutions involved. In all of the sites visited that included saltwater dikes, respondents affirmed that "everyone" participated, including older men and women, members of the founding lineage, the village headmen and their families, and other notables. In one village, the egalitarian nature of participation was underscored by one respondent who noted as proof that "even the Imam worked."

The critical factor explaining widespread participation in the reclamation of swamp lands by building saltwater intrusion barriers was the decision made by the communities to distribute benefits in an equitable manner among all participants. In effect, each adult woman received at least one plot for swamp rice cultivation in the area reclaimed by the infrastructure. This meant that <u>every</u> family would benefit, and that the benefit in question would be one that was shared by all those within the domestic consumption unit In each site visited, respondents confirmed that there were no groups or individuals who were clear losers or who were systematically denied equal access to benefits. In some cases, such as Tendaba, Njawara, and Kembujeh, even "outsiders" -- such as residents of neighboring villages or recent wives brought from other areas -- were given plots.

In those cases where participation was low during construction of the infrastructure, maintenance was more problematic and the sustainability of the activity is placed in question. This was most evident in the case of contour berms and may be linked to factors such as the lack of significant short-term benefits in the form of increased production and the spatial organization of landholdings which may have made contour plowing and planting inefficient from a labor standpoint. In contrast, the establishment of saltwater intrusion barriers generally elicited widespread interest and a willing commitment of labor by the entire village community.

Ineffective Linkage: The Case of Range Management: A very different experience was revealed in the case of improved grazing plots initiated by MFP. Plots of varying size but usually of 0.5 to 1.5 hectares were established to test improved forage and grass varieties, deferred grazing, seed multiplication, and crop residue feeding programs, among other activities. The village institution selected for participation was the Livestock Owners Association (LOA). LOAs were an existing organizational form, encouraged by the government for the marketing of livestock. After explaining the proposed activity, the local headman was asked to designate a site, and local LOA members were asked to provide labor for building the fence around the site. MFP would provide fencing materials and grass seeds (or seedlings) to transplant. LOA members were responsible for preparing the field, digging the post-holes, planting or transplanting the seedlings, and maintaining the fence. Management of the range plot, for example the opening and closing of the gates and determination of access, seems to have been left to LOA members as well.

At the time this activity was introduced, LOAs were especially oriented toward cattle owners who were generally men. Range resources, on the other hand, are a common good open to all. Goats and sheep, often owned by women, as well as cattle all had access to pasture resources. The improved range plots appeared to be no exception. During the dry season when pasture resources were low, the gates of the improved range plots were opened and all who had animals in the area were allowed to enter. In the case of one site, this extended to livestock owners from neighboring areas as well. Since livestock numbers quickly exceeded the carrying capacity of the small trial plots, overgrazing occurred and in some cases destroyed the trial varieties. Since access to the common resource was not controlled, there was no way to maintain a clear linkage between participation and benefits. When the fences fell into disrepair, little if any effort was expended to maintain them, again due largely to the lack of a clear incentive to participate.

At the sites visited, the range plots had not been maintained and did not appear to be in use for deferred grazing, and according to knowledgeable ministry sources this was true in most cases. No initiatives appear to have been made to spread the use of the improved grass varieties, despite recognition by livestock owners that some of the test varieties were very good for providing dry season pasture. A common explanation for the failure of the range plots was that the fence had fallen down and/or that the grass varieties had been killed by overgrazing.

There are a number of factors which contributed to the failure of this intervention.

- The demand for the activity came from outside the population that was to benefit.
- Little actual contribution was required or expected of those who theoretically were to receive the benefits (the LOA members); most inputs were provided by the project.
- There did not appear to be a sustained public education and extension effort integrated with the activity.
- While all LOA members (men from the village) were said to have participated by providing labor, access to benefits was not controlled.
- Nothing was done to strengthen the capacity of those who used the range to manage its use effectively.

The choice of local institutions, while seemingly appropriate, did not correspond with the population of resource users. This made it difficult for the local LOA to control access to the improved range plots and to establish a clear linkage between participation and benefits.

Land and Resource Tenure Systems

National and local institutions can be considered not only in terms of their organizational form but also in terms of agreed upon rules and behavior. The institution of land and resource tenure is inextricably linked to agricultural sustainability, and A.I.D.'s programs in The Gambia are addressing this relationship in innovative ways. In response to the growing awareness that popular involvement in resources management is necessary to halt and reverse the rate of natural resource degradation, a number of pilot efforts have been initiated to enhance community control over key resources.

Past Experience: The longest such experience in The Gambia has taken place under the UNDP-supported Rangeland and Water Development Project (1986-1992) in Dankunku and Niamina West districts. From its inception, this project has emphasized community participation in the management of the common range area used by livestock owners in the two districts, and the model is being adapted for other areas.

SWMU has made Community Resource Management Agreements (CRMAs) an important part of its approach toward working with communities. Although these agreements are not written, they are formal understandings and their use is a necessary precondition for SWMU to work with communities. By 1992 SWMU had negotiated 133 agreements, 101 for upland stabilization and 32 for lowland rehabilitation (DeCosse, 1992).

The German technical assistance agency (GTZ) and the GOTG initiated pilot activities in the area of community forestry in 1989, and in 1991 a community forestry management agreement was signed by the community of Brefet and the GOTG. Along with the authority to manage the forest, the agreement provides special exonerations from forestry license fees, prohibits the granting of licenses to outsiders, and confers the right to collect and manage revenues generated from the sustainable development of the forest.

The ANR project has given special priority to the establishment of written CRMAs in forestry, agriculture, and range management; Annex B provides an example of a CRMA. The CRMA is viewed as a key instrument allowing communities to assume management control of, and benefit financially from, local land-based resources. The adoption of this instrument reflects a fundamental change, or evolution, in A.I.D.'s perception of the role of rural populations in resolving environmental conflicts and halting degradation of the resource base. The focus has changed from simple participation to local management and empowerment.

Future Implications: Land tenure systems in The Gambia are similar in structure to those found throughout much of West Africa. Founding lineages hold primary rights to land areas that were unclaimed upon their arrival. Land is granted to new arrivals in the form of an outright grant of permanent usufruct, a long-term loan, or a short-term loan. Land is also held by the extended family unit, with collective fields being farmed by all household members and individual plots assigned to men and women for their own production activities. Within this general model, there is substantial variation by region and ethnic group. The important feature of Gambian tenure is its flexibility. Studies conducted by the Land Tenure Center (LTC) at the University of Wisconsin have found that Gambian customary tenure systems ". . . are not static but show considerable flexibility in responding to needs for rule changes created by increasing population densities, new technologies and new markets" (Bruce *et. al.*, p. 5). Tenure specialists at the LTC have recommended the acceptance of an adaptation model of tenure evolution rather than the replacement of customary tenure with state-conferred tenure.

The use of CRMAs, which are agreements between resource users and the state, will tend to reinforce the rights and authority of communities and organized groups over resources specified in the agreement. If properly managed, this may lead to enhanced security of tenure, increased investment in the sustainable development of the resource base, and improved productivity. These agreements and resource management plans may also serve as grounds for the granting of long-term (99 year) leases over a clearly defined area to the institution which has been conferred authority in the agreement. This is one approach under consideration by officials in the Department of Livestock Services who see the eventual obtainment of a formal lease as a means of protecting range resources from being converted into agricultural or other uses. A.I.D.'s support for the development and monitoring of CRMAs represents an important contribution to the reduction of environmental degradation in The Gambia.

4. Policy Environment

The policy environment is often a critical factor associated with the success or failure of environmental programs in the area of sustainable agriculture. In The Gambia, the economic policy environment, in particular, changed dramatically between 1978 and 1993.

In 1978, when A.I.D. began supporting soil and water conservation activities, the government regulated much of the economy, including the large (in employment terms) agriculture sector. The Gambia Produce Marketing Board (GPMB), a parastatal, was the sole importer of rice (the preferred cereal throughout much of the country) and the sole buyer of groundnuts (the country's main foreign exchange earner). The government also regulated the prices and distribution of agricultural inputs (such as fertilizer and seeds). The overvalued foreign exchange rate, set by the government, tended to discriminate against agriculture.

In 1985 the government launched its economic recovery program which liberalized the economic policy environment and stimulated private sector growth. Today, in 1993, domestic prices of agricultural inputs and outputs are determined by the market not by the government; many state-owned enterprises and parastatals, including the GPMB, have been sold; and the dalasi is a freely floating currency whose value is determined by market forces. In October 1993 a local newspaper reported that the International Monetary Fund had singled out The Gambia (together with three other developing countries) for having made substantial progress in economic liberalization.

According to the MOA's Department of Planning, the major weakness of the A.I.D.-supported sustainable agriculture activities was that they did not focus on the policy environment. It is true that the design and implementation of these programs paid little attention to the policy framework; however, it does not appear that this was a major problem, at least from an economic perspective. This is because the main beneficiaries of the program were rice producers, and the rice that was being produced was for home consumption, not for sale in the market where economic policies play a critical role.

In fact, the soil and water conservation program was highly successful over the entire 13 year period, regardless of which economic policies were in place: farmers constructed saltwater intrusion dams before 1985 during the period of economic regulation as well as after 1985 during the period of economic liberalization. Although some farmers might have been adversely affected by the increase in fertilizer prices (and prices of other purchased inputs) that accompanied economic liberalization, most farmers did not need purchased inputs in order to enjoy a substantial increase in rice production. That is, increased production could be realized through acreage expansion made possible by improved soil and water conservation methods, without purchased inputs.

Of course, appropriate economic policies are critical to encourage the production of commodities that will be sold in the market. For example, a farmer's decision to raise cattle, plant maize, or produce vegetables is clearly influenced by the economic incentive structure that is in place. However, it is not clear that the choice to grow a subsistence crop, in this case rice, was affected, one way or the other, by the policy environment.

It is important to note that A.I.D. provided long-term advisory services to the Ministry of Finance and Economic Affairs beginning in 1985 when the economic recovery program was launched. That program has created an economic environment in The Gambia that is more conducive to economic growth. Therefore, to the extent sustainable agriculture activities are stimulated under a positive enabling environment, the economic liberalization program supported by A.I.D. has helped to create that environment. The new ANR program will play a much stronger role in the area of environmental and natural resource policy.

Thus, the changing economic policy environment in The Gambia during the past 15 years generally had a neutral effect on the relative success of sustainable agriculture activities. On the other hand, A.I.D. support of the government's economic liberalization program helped to create a macroeconomic policy environment conducive to more efficient resource allocation. In the longer term, this may provide an incentive for farmers to produce agricultural commodities to sell in the marketplace. In any event, farmers are likely to continue to practice sound soil and water conservation measures (by maintaining the dikes) in order to benefit from the increased rice production they permit.

Table 1 summarizes the various conditions associated with the adoption of sustainable agricultural technologies and practices at the sites visited by the evaluation team.

Table 1. Conditions for Adoption of Sustainable Agricultural Practices, The Gambia

Village	Alternate Opportunity	Short-term Benefits	Demand Driven	Participation Benefit Link	Local Institutions	Market Exists	Right Technology
Lowland Salt Intrusion Dikes and Water Retention Dams							
Bakindik	None	High	Yes	Strong	Strong	No	Yes
Jufureh	None	High	Yes	Strong	Strong	No	Yes
Njawara	None	High	Yes	Strong	Strong	No	Yes
Tendaba	None	High	Yes	Strong	Strong	No	Yes
Kwinella	None	High	Yes	Strong	Strong	No	Yes
Sintet[a]	None	Moderate[b]	Some	Moderate	Moderate	No	Yes
Kembujeh	None	High	Yes	Strong	Strong	No	Yes
Contour Berms and Contour Farming							
Njawara	None	Moderate[c]	Yes	Strong	Strong	No	Yes
Sera-ngai	None	Moderate[c]	Yes	Moderate	Unknown	No	Yes
Sintet	Some	Low	No	Weak	Moderate	No	Yes

Explanation of Columns:

Alternate Opportunity: In the context of SWMU's work and the lowland rice areas chosen for rehabilitation, alternate opportunities generally refer to other lands that could have been developed or improved for rice production, assuming moderate to low capital investment costs, reasonable returns to labor, and adequate food security.

Short-term Benefits: Short-term benefits are those which are realized within one or two seasons after implementation of the intervention.

Demand Driven: "Yes" indicates that all or most of the participants requested or supported implementation of the intervention.

Participation-Benefit Link: "Strong" indicates that the participants perceived clear and direct benefits resulting from the work that they put into

[a] The community problems and dissension in Sintet have been documented by Freudenberger et. al. in a study of the Foni Jarol Conservation District done by the Land Tenure Center.

[b] In Sintet, SWMU installed a water retention dam in an area where soils were not yet severely degraded and rice yields had not fallen sharply. As such, the short-term benefits realized from putting in the dam were not as noticeable as in the other sites visited.

[c] There were striking short-term benefits in village flood control, but short-term yield improvements were only moderate, and then only in areas most affected by rainfall runoff.

building the conservation structures.

Local Institutions: The existence and strength of a local institution, usually the community conservation or community development committee, is assessed. At all sites, the presence of a strong national institution -- SWMU -- was also a very important pre-condition for adoption.

Market Exists: In the case of lowland rice and upland crops, nearly all of the production was consumed within the household. In some of the swamp rice areas there is off-season vegetable gardening, with subsequent cash income from the sale of vegetables, but the primary impetus for the adoption of salt intrusion barriers and water retention dams was to increase rice production. Even women who did not have vegetable gardens and cash income wanted to rehabilitate their degraded swamp rice lands.

Right Technology: The soil conservation technologies fit well because they required little labor and no capital investment after construction.

B. Program Impact

The second area of evaluation findings concerns the impact of A.I.D.'s sustainable agriculture program in The Gambia. It focuses on three levels of program impact: impact on practices; biophysical impact; and socio-economic impact.

1. Impact on Practices

Rice is an important crop for Gambian farmers. An estimated 61 percent of agricultural households are involved in rice production (DeCosse, 1992). The salt intrusion dikes and water retention dams reduce salinity and permit higher water tables. This results in increased cultivatable areas and higher yields without necessitating the farmers to make changes in their traditional farming practices.

Lowland rehabilitation also increases opportunities for vegetable production, an important economic activity that takes place during the dry season. About 10 percent of the agricultural population, primarily women, are involved in vegetable production (DeCosse, 1992). Rehabilitation of swamp lands increases the land area that women can devote to vegetable production, thereby permitting increased off-season food production and increased income generation.

Contour berms, which reduce sheet and rill erosion, are designed to help guide farmers when they plough their fields and to help stop downslope rainfall runoff during heavy rains. Instead of plowing up and down the slope, which increases soil erosion problems, farmers change the direction of their plowing so that it is on the contour and parallel to the berms. Both heavy rainfall runoff reduction and contour plowing help to reduce gully erosion and flooding.

SWMU has had a significant impact on getting farmers to build and maintain contour berms (an intervention less popular with farmers than dikes and dams). Country-wide, an estimated 1 percent of groundnut fields and 1 percent of cereal fields have contour berms stabilized with grass (DeCosse, 1992). This represents only a small percentage of the cultivated uplands. However, if one assumes that the contour berms were adopted on the steepest slopes and most important croplands, which are the most susceptible and fragile areas, then this is probably quite significant.

2. Biophysical Impact

SWMU's conservation structures for lowland or swamp rice have had a very significant positive impact. According to the MOA's Department of Planning, from 1984 to 1989 the average harvested area of lowland rice was about 10,500 hectares. Table 2 shows that since the inception of its field activities in 1983, SWMU has rehabilitated about 1,611 hectares planted to lowland rice (Updegraff *et. al.*, 1991; SWMU Annual Reports for 1991 and 1992; SWMU for 1993). This means that SWMU has rehabilitated about 15 percent of the lowland rice area in the Gambia[a]. Given that increases in productive land area and yield in the areas where salt intrusion dikes and water retention dams have been built is quite high, relative to the total area of cultivated lowland rice, it is clear that the biophysical impact is also quite high.

The construction of salt intrusion dikes increases swamp land for rice production, which could also lead to an increase of water borne diseases, especially malaria and bilharzia. However, the evaluation team did not find any evidence of these negative effects. It should be kept in mind that much of SWMU's work does not result in completely new areas of swamp rice cultivation. Rather, its dikes and dams usually serve to improve existing production areas.

The biophysical impact of the upland conservation structures is not as great as the lowland dikes and dams; but it is still significant. Since 1983/84, upland conservation structures have been installed on about 1,920 hectares (Table 2). Nearly all of this land is planted to either maize, millet (early and late), grain sorghum, or groundnuts. According to the MOA's Department of Planning, between 1985 and 1989 an average of 143,600 hectares were devoted to these crops annually. Thus, the area of potential impact for SWMU's upland structures is about 1.3

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[a]Acreage planted to lowland rice varies considerably from one season to the next because of the highly variable rainfall in the small watersheds which feed the swamps and lowlands. For example, in 1985 the area planted to lowland rice was only 7,300 hectares, whereas in 1988 it was nearly double that at 14,000 hectares.

Table 2. Area, Number of Villages, and Population Covered by SWMU's Conservation Programs, 1983/84 to 1992/93, The Gambia

Year	Lowland Rice Rehabilitation (ha)	Upland Soil Conservation (ha)	Number of Villages Affected	Approximate Population Affected
1983/84	25	373	5	1,000
1984/85	124	280	14	2,800
1985/86	150	158	14	2,800
1986/87	130	50	15	8,000
1987/88	75	520	14	2,800
1988/89	156	0	8	1,600
1989/90	120	250	8	1,600
1990/91	314	110	29	3,529
1991/92	253	114	19	2,530
1992/93	264	65	14	2,870
Total	1,611	1,920	140	29,529

Source: Soil and Water Management Unit and Updegraff *et. al.*, 1991

percent of the total area planted to the main upland crops. Even if one reduced this estimate by one fourth to account for areas where the conservation structures have been abandoned or have deteriorated significantly, the area of biophysical impact would still be around 1 percent.

The absence of these upland conservation structures may well have had severe consequences. Soil erosion on continuously cropped fields with a slope of about 2 percent would lose about 12.5 tons of soil per hectare per year (Shulman *et. al.*, 1991). Soils of The Gambia could not sustain this rate of loss year after year without long-term reductions in soil organic matter, soil fertility, moisture holding capacity, and nutrient retention capacity -- and, in turn, reductions in crop yield.

The magnitude of the impact of contour berms is difficult to determine. The yield figures presented by Updegraff *et. al.* are clearly rough estimates, and they probably do not occur in the first few years after the contour berms are installed. Moreover, the farmers interviewed by the evaluation team did not credit contour berms for increasing grain yields of upland crops as enthusiastically and as often as lowland rice farmers credited dikes for increasing rice yields.

Nonetheless, there are positive impacts from upland conservation including reduced flood damage to upland fields and villages, increased moisture retention of valley and swamp rice, and reduced yield loss caused by siltation in valleys and swamps. And while there are no data available to estimate the magnitude of these impacts, the farmers at Njawara and Sare-ngai believed that the positive impacts from installing contour berms and practicing contour farming on their upland fields were quite large.

Thus, the biophysical impact of salt intrusion dikes, water retention dams, and soil erosion contour berms -- when they are installed properly and maintained by farmers -- are clearly positive. They effectively protect soils from erosion on the upland slopes and rehabilitate and protect saline soils in the lowland swamps. Crop yields, particularly swamp rice, increase significantly, water tables rise, soil and gully erosion is reduced, and saline soils can be cultivated again.

3. Socio-economic Impact

The socio-economic impact of technologies such as salt water intrusion barriers is clearly positive. These interventions directly benefit the most vulnerable sub-populations (women and children). They permit additional land to be brought into production, thereby increasing swamp rice production largely for household consumption and they create opportunities for earning money through dry season vegetable production. Similarly, the fattening of goats prior to sale makes efficient use of existing forage resources while offering the potential of larger profits for producers. Since small ruminants are generally a women's activity, much of the profit accrues to a group often excluded from the benefits of improved agricultural technologies.

Contributions to Agricultural Production: A.I.D.-supported sustainable agriculture activities have resulted in substantial increases in farm level production by:

- Reclaiming agricultural lands lost to salinization through the construction of salt water intrusion barriers.

- Decreasing topsoil losses from erosion through the construction of contour berms and grass waterways.

- Improving soil fertility by promoting appropriate cultural practices including composting and agroforestry.

Other activities supported by A.I.D., other donors, and the GOTG have contributed to increased agricultural production including: (a) the introduction and extension of improved seed and technology packages for corn, rice, and sesame production and improved grass and forage varieties; (b) the protection of the natural range from bush fires and the establishment of access routes to dry season pasture and water sources; and (c) the introduction of improved animal husbandry practices including managed grazing, crop residue feeding, goat and sheep fattening for specialized marketing, and the integration of crop and livestock production.

Most of these practices and technologies have been adopted or instituted across the country and have provided direct benefits to all participating social groups. Some practices have been of greatest benefit to women, such as improvements in swamp rice production. Other practices have benefited those already engaged in a particular production activity, such as livestock, but at the same time have expanded access to those not previously engaged. This was the case with improved range management in an area of Dankunku, where people who had never owned cattle were able to invest in this economic activity for the first time.

Contributions to Household Food Security: One of the most significant impacts of the soil and water conservation activities was the effect on household food security. Lowland rice production in The Gambia is traditionally a women's activity. The produce from these fields is used almost entirely for consumption by the family, with only very small amounts sold for emergency purchases or cash needs. Respondents at all sites with salt water intrusion barriers or water retention dikes uniformly confirmed that: (a) production increased substantially even in the first year following completion of the infrastructure; and (b) the food produced was consumed within the family unit. The increase in production was commonly quite dramatic. In one village, women confirmed that they were able to harvest from one plot what they typically harvested from three plots before the dike was constructed. In Njawara, rice was cultivated on plots that had been out of production for over a decade. In some cases, it was reported that village residents were to the point of relocating due to the lack of adequate farm lands and low yields, but the soil and water conservation measures permitted them to continue farming in the same locale.

In many of the lowland areas reclaimed by conservation infrastructure, dry season vegetable production was practiced. The increased water retention allowed women to raise what is essentially a cash crop following harvest of their rice fields. In upland areas, the construction of contour berms and other water retention and anti-erosion measures resulted in increased production of millet, sorghum, corn, and peanuts. This in turn improved food security while contributing to the ability of producers to market any surplus.

Other measures introduced under A.I.D.-supported activities such as improved range management, feeding crop residues to animals, and specialized fattening of animals also contributed to household food security by diversifying production and thereby spreading risk across a larger number of food and income generating activities. Household food security was also enhanced because both women's and men's production activities were effected by these measures.

Contributions to Household and Producer Income: Household and producer incomes were effected positively by many of the measures introduced in sustainable agriculture. The promotion of the improved maize variety, NCB, under MFP met with widespread adoption. The increased maize yields created a new and significant cash crop for farmers.

Other measures, such as ram fattening, have helped to increase producer incomes. While the evaluation team was not able to determine the extent of adoption of this practice or the return on investment, it was clear from interviews in various sites that both women and men were participating. The fattening regime involves principally the use of crop residues such as groundnut hay and corn stalks, and therefore the cost to producers is low.

Less tangible effects on income are also worth noting. One of the comments made repeatedly by both men and women in regard to increased rice production from lowland fields is that this allowed the family to eat for a number of months without being obliged to purchase rice or other foodstuffs. While this does not produce income since the produce is not marketed, it does allow the money saved to be used for other needs. Furthermore, the money earned by women from dry season vegetable production can be used to purchase clothing, school supplies and uniforms, and to meet other consumption needs.

Contributions to Social Well Being: Other important impacts observed during the site visits improved social well being. Soil erosion in The Gambia is a problem not only because of the loss of topsoil and resulting drop in soil fertility. Erosion, which is generally caused by uncontained water flows, can also create flooding. This was the case in Njawara and was perhaps the principal reason the villagers requested SWMU to intervene. Flooding was creating havoc in the village, eroding walls and causing houses to collapse. The population was faced with a very serious problem which fortunately could be controlled through the use of upland conservation structures. The combination of contour berms, reinforced roadways, and grassed waterways has effectively ended the threat to the village.

Another social benefit has been the clear improvement in women's control over subsistence production in their traditional fields and the opportunities created for income-earning activities such as vegetable production and ram fattening. Without access to lowland rice production areas, women were less able to provide for their families and more dependent on men who controlled access to upland fields.

C. Program Performance

The third area of evaluation findings concerns program performance, which is assessed using four measures: effectiveness, efficiency, sustainability, and replicability.

1. Program Effectiveness

There are three principal components of program effectiveness: (a) coverage, or the extent to which program activities and benefits were available to all members of the intended beneficiary population; (b) equitable access, or the degree to which participation in activities and benefits was open and accessible to all potential beneficiaries; and (c) intended consequences, or the extent to which the anticipated benefits and effects of the activity or technology were realized. A program is therefore relatively effective if it reaches the population it intends to benefit, if all who can benefit from the activity have an equal opportunity to do so without undue restriction, and if the results or outcomes are generally those that were anticipated and desired in the design of the activity. On all three counts, the sustainable agriculture activities supported by A.I.D. in The Gambia were effective.

In large measure, the effectiveness of the soil and water conservation measures was due to: (a) the selection of a comparatively simple and low-cost technology; (b) the direct and almost immediate linkage between the problem and the proffered solution (loss of productivity due to saltwater intrusion -- construction of a saltwater barrier); (c) the ability to demonstrate short-term benefits to those participating in the activity; and (d) the willingness of community members to redistribute reclaimed and new lands brought into production on an equitable basis.

Coverage: SWMU has been active in many regions of the country, although its activities are concentrated in the western half where salinization of rice lands is a critical problem. Since it began constructing conservation structures in 1984, the unit has been able to treat nearly 15 percent of lowland rice fields. This is a very significant accomplishment for a newly created technical service and represents a highly satisfactory level of coverage of intended beneficiaries. Given adequate recurrent cost financing and the replacement of essential equipment, there is every reason to expect that full national coverage will be attained. Even in areas where SWMU has not yet provided any infrastructure, awareness of conservation practices is growing since many if not most mid-level agriculture staff and village extension agents have received some form of education in conservation practices and potential, through training opportunities offered by A.I.D. or GTZ, in courses or seminars offered at Gambia College, or in-service training through the Department of Agricultural Services.

In contrast, the range improvement and animal husbandry technologies were most widely adopted in those divisions that make up the principal livestock and range areas of the country (especially MacCarthy Island Division and Upper River Division). Similarly, the adoption of improved corn varieties was most widespread in the ecological zones most conducive to corn production (such as the south bank). Other practices, such as the use of crop residues for livestock fattening or dry season fodder, were adopted more widely since they were less ecologically sensitive.

Equitable Access: The low cost of adopting many if not most of the recommended technologies, in terms of time, labor, increased risk, financial cost, and compatibility with existing practices, was such that few producers, men or women, would be excluded. Indeed, as has been noted above, many of these technologies were of particular benefit to women. This was the case even for the range interventions since small ruminants also derived benefit from improved pasture resources due to managed grazing and the use of crop residues.

Similarly, one of the most promising aspects of the specific technologies offered by SWMU is that access to and participation in benefits tends to be very widely generalized throughout the population. In most lowland areas, every household in the community benefitted since all women were given equal access to plots in the reclaimed and/or protected area. Not all plots were the same in terms of production potential; some had hot spots where salinization remained a problem; others were partially flooded when water retention behind the dike was at its highest. Nevertheless, there did not appear to be any form of systematic bias in the allocation of plots nor were any subgroups that had established ties to the village denied the right to farm a plot. In the case of upland fields, existing usufruct rights were maintained and fields were not redistributed following the construction of infrastructure such as contour berms. Infrastructure siting was based on topographic, rather than on equity, considerations; nevertheless, once constructed all those with fields in the affected area tended to benefit similarly. In some cases, the spatial arrangements of some individual fields did not correspond to the lay out of the contours, and hence benefits from the infrastructure may have been reduced.

Intended Consequences: The accomplishments of SWMU are undeniable and clearly address the principal objective, that is, to halt and reverse the rate of degradation of land and water resources. In the process, Gambian farmers are gaining awareness of the importance of their soil resources and of measures that can be taken to conserve them. Furthermore, a very capable technical service with motivated and well-trained staff has been created and institutionalized. Similarly, A.I.D. investments have been effective in institutionalizing a national applied research capability, in establishing a system for managing agricultural research, and in developing a supportive institutional environment for agricultural research. The GOTG has responded to the termination of A.I.D. funding at the end of the project by increasing recurrent cost allocations to the Department of Agricultural Research. While problems remain and the long-term sustainability of both agricultural research and soil conservation interventions is not guaranteed, one indisputable fact stands clear: these institutions have been created and have been functioning at a very respectable level of performance despite the decline in external funding made available to them. They have been successful in providing real and tangible benefits to rural producers and have the potential of continuing to do so.

2. Program Efficiency

The results of the A.I.D.-supported sustainable agriculture program in The Gambia have clearly been effective. However, it is important to assess these program results or benefits in relation to program costs. The U.S. Soil Conservation Service and SWMU recently completed a benefit-cost analysis of the SWM project, the methodology and results of which are summarized below (Updegraff 1991).

The cost calculation for the analysis included donor assistance (both U.S. and German), support from the GOTG, and village support. Altogether, total costs (in 1990 dalasis) were 53,281,100 dalasis; of this, the U.S. contributed 41,360,000 dalasis, or 78 percent.

The benefit calculation included only monetary benefits, and therefore the benefits are underestimated. The monetary benefits were derived from increased crop yields for six major crops (lowland rice, upland rice, groundnuts, maize, sorghum, and millet) as well as from reduced flooding in selected villages. The benefits were calculated by comparing the net returns of these six crops "with" the project and "without" the project. This comparison, in turn, was based on estimates of four key variables including the number of hectares planted to each crop; crop yields with and without the project for each crop; commodity prices for each crop; and the number of hectares benefited by the project.

Based on estimates for each of these variables and using a discount rate of 10 percent, the present value of project benefits during the 13 year project period (1978 to 1991) was estimated at 17,424,000 dalasis (in 1990 dalasis). The present value of benefits associated with continuing the project during the following 14 year period (1992 to 2006, which is the break-even year) was estimated at 7,094,000 dalasis. Virtually all of these benefits resulted from yield increases of the six crops; less than two percent of total monetary benefits resulted from reduced flood damage.

Benefit-cost analyses were carried out for the two different time periods. Table 3 shows results of the analyses for both periods. During the donor phase, which was the 13 year period from 1978 to 1991, the benefit-cost ratio is 0.76: benefits are less than costs, indicating that the project is not economically viable over that time period.

Table 3. Soil and Water Management Unit, The Gambia, Benefit-Cost Summary

Period	Cost	Benefit	B/C
1978-1991	23,034,000	17,424,000	0.76
1992-2006	1,370,000	7,094,000	5.18
1978-2006	24,404,000	24,518,000	1.00

Note: Present values in 1990 dalasis discounted at 10 percent.

Source: Updegraff, The Gambia Soil and Water Management Unit Activity Review, 1991.

The break-even year for the project is 2006, which is the year in which project benefits just equal project costs and the benefit-cost ratio is 1. This is the time period most relevant for other African states that have conservation problems similar to those of The Gambia that may be considering whether or not to apply the technology in their own countries.

When the period of analysis excludes the donor phase (treating those expenditures as sunk costs) and instead includes only the 14 year period from 1992 to the break-even year (2006), the benefit cost ratio is 5.18: each dollar expended returns 5.18, which is a very attractive rate of return. This is the most meaningful time period from the point of view of the GOTG in deciding whether or not to continue to invest in soil and water conservation activities.

3. Program Sustainability

Institutional Sustainability: A.I.D.'s efforts in strengthening Gambian technical services have been very successful in terms of the quality of technical personnel and overall performance. SWMU in particular represents one of the more productive, technically capable, and dedicated services one is likely to encounter in Africa. Two factors, however, constitute serious threats to the long-term sustainability of this and other institutions strengthened under A.I.D. program efforts. The first and most critical factor is the provision of adequate budgetary support from the GOTG or other sources to assure continued operation, replacement of equipment, and compensation for field staff while away from post. At the present time, GOTG recurrent cost support is limited essentially to the payment of salaries for SWMU staff. Although this contribution demonstrates GOTG commitment to support the efforts of the unit by hiring needed technical personnel, SWMU is still currently unable to meet the growing demand for its technical services given the level of budget support.

The second factor that threatens institutional sustainability concerns the retention of trained personnel. At the present time, SWMU and other services such as agricultural research have been fortunate to retain most of their trained manpower. However, given the uncompetitive salary structure and lack of other performance incentives, there is a strong possibility that efforts to attract technical personnel away from government service will be forthcoming.

Maintenance: The maintenance of the lowland conservation structures, mainly the salt water intrusion dikes and water retention dams, is excellent. The dikes and dams were in good condition in all of the areas visited by the team. At some locations it was obvious that the villagers had made repairs to the structures, and everyone interviewed indicated that they would have no trouble keeping the structures maintained.

The maintenance of the contour berms is more problematic. In one village the farmers were very interested in maintaining the contour berms; in another, more than half of the berms had been plowed up and eliminated by the farmers; at a third site, farmers were not maintaining the contour berms very well, but they did continue to plough on the contour which was effective at controlling soil erosion and rainfall runoff.

Clearly, the maintenance, and therefore the sustainability, of upland conservation structures is more problematic than for the lowland structures. Farmers have the capacity to maintain the upland structures, and it seems that in cases where they see a clear benefit, such as reduction or elimination of severe soil erosion or flooding, they will do so.

Financial Sustainability: A.I.D., through SWMU, funded the initial soil and topographic surveys and design work required to construct salt water intrusion dams. A tractor was also provided to loosen the soil used to construct the dikes and to transport stones and cement used to construct small spillways. These initial costs are substantial and probably not amenable to recovery from poor rural villagers. Therefore, the programs will probably never be financially self-sustainable in the sense that these initial costs will be completely borne by the beneficiaries.

As far as future construction is concerned, the sustainability of the program will depend on whether or not resources are made available by the government (or a donor) to finance these substantial up-front cash costs. It is also possible, however, that the villagers themselves may be able to cover a portion of these costs. There certainly appears to be a willingness to do so in view of the fact that the salt water intrusion dams and other infrastructure that have been constructed with A.I.D. assistance have, to date, been well maintained by the beneficiaries.

4. Program Replicability

The basic approach of using dikes and dams to stop salt water intrusion and raise water tables in lowland rice areas is replicable. However, most of the soil and water conservation structures promoted by SWMU are not "spontaneously replicable" in the same way as technologies such as composting, row seeding, and improved crop varieties. The complex nature of the design of salt water intrusion dikes and retention dams places a premium on having a well-trained group of professionals available to design the structures and to supervise their construction. In this sense, farmer-to-farmer replication of SWMU technologies will be difficult to achieve without continued technical support from SWMU or other sources.

In several cases villagers wanted to build additional structures. For example, in the village of Jufureh, the farmers built a 1,000 meter dike that had been designed by SWMU. The next season they added another 1,000 meters with design assistance provided by SWMU. They added a third 1,000 meter stretch in the third year, again with SWMU assistance. At several other swamp rice sites visited by the evaluation team, the villagers had tried to build their own dikes. These failed because they were not designed properly, and they turned to SWMU for assistance.

In the early phases of implementation the technology requires substantial up-front costs. Therefore, the technology can be replicated, but only if resources are available to finance the front-end cash outlays and to fund the cadre of trained professionals needed for the design and supervisory work.

Maintenance: Not only are the concepts of conservation structures replicable, but also the techniques for constructing and maintaining the dikes, dams, and berms are replicable. Digging and moving soil are certainly skills which villagers have, and as long as trained technicians handle the design and placement of the conservation structures, the field work can be done locally. Likewise, maintenance of the dikes and contour berms is not difficult and can be carried out by villagers. In several instances the evaluation team found that farmers had repaired contour berms or dikes on their own initiative.

These implementation and maintenance techniques, though replicable, may not always be replicated. In Njawara and Sare-ngai there was severe sheet and gully erosion which resulted in dangerous village flooding, and farmers perceived the benefits of building and maintaining contour berms. In contrast, in Sintet farmers saw few benefits from the berms they had built and did not maintain them. Clearly, perception of benefits is a key factor in determining replicability of interventions.

Summary

Thus, the A.I.D. program in the area of sustainable agriculture in The Gambia has generally been effective and efficient, and it has the strong potential to be both sustainable and replicable. In large part this reflects the benefits from the soil and water conservation activities which are very impressive. Box 1 summarizes these benefits.

Box 1. Benefits of Soil and Water Conservation

National Economic Development:

- Increased income from increased agricultural production
- Internal rate of return of 10.6% (1978-2006)
- Benefit-cost ratio of 1.0 to 1.0 (1978-2006)

Social Well Being:

- Improved community morale
- Increased unity between and within villages
- Optimistic attitude toward country's future

Environmental Quality:

- Protection of agricultural land from salinity
- Reduced sedimentation
- Improved health conditions

Governmental Effects:

- Reduced unemployment
- Reduced agricultural subsidies
- Reduced government food aid

Source: Shulman *et. al.*, 1991.

IV. LESSONS LEARNED

1. **A new agricultural technology or practice is more likely to be adopted when the intended users have few other options for achieving food security.** This was the case in The Gambia, where over the past 25 years reduced rainfall levels had permitted extensive salt water intrusion in the lowland rice fields thereby making that land virtually unproductive; reduced rainfall also made upland cultivation of groundnuts, maize, millet, and grain sorghum increasingly less productive. The construction of salt water intrusion dikes in the lowlands and contour berms in the uplands -- the principal technologies introduced by A.I.D. -- stops salt water intrusion, impounds rainfall run-off, and reduces soil erosion. This, in turn, permits significant increases in lowland acreage and total production (both lowland and upland), and at the same time enhances the natural resource base and improves the environment.

2. **Technologies that yield significant benefits in a relatively short period of time are more likely to be adopted than those that yield positive (but less dramatic) benefits only over the longer term.** In The Gambia, rice production doubled and sometimes tripled -- in one year -- in areas where the saltwater intrusion dams had been constructed. The benefits from contour berms were typically less immediate and less appreciable, and adoption of this technology was less widespread.

3. **Technologies for which there is a clear demand on the part of the intended beneficiaries are more likely to be adopted and sustained than those which are proposed (or imposed) by governments, donors, NGOs, or other external entities.** In The Gambia, the interests and priorities of the intended beneficiaries were demonstrated in two ways: first, by their initiating a request for the government to design a saltwater intrusion dam specific to their locality; and second, by their volunteering their labor to construct and maintain the dam.

4. **A new technology is more likely to be adopted if it is easy to maintain, places only minimal additional demands on labor, and requires few changes in existing practices.** In The Gambia, the saltwater intrusion dams satisfied all three of these criteria; in particular, farmers were able to benefit from the dams without altering their traditional cropping practices.

5. **Collective action is most effective when there is a clear linkage between peoples' participation in a common effort and the benefit that is derived from such participation; and, when the work can be completed relatively quickly.** In The Gambia, those who worked to construct and maintain the saltwater intrusion dams clearly reaped the benefits afforded by the dams in the form of increased rice yields; the work typically required about 12 days

over the course of one month during the first year, and less than one week each year thereafter. Local organizations often played a catalytic role by encouraging collective action and participation.

6. **Strong institutions at the national level, which are essential for designing technically complex conservation infrastructure, require a long time to develop and mature.** A.I.D. supported The Gambia's Soil and Water Management Unit for 13 years, and staying the course has had a large payoff.

7. **The maximum benefits of conservation technology can be achieved and sustained only if the users of the technology have continued access to technical advice.** Therefore, institutions, once developed, must be provided adequate financial and human resources on a regular basis so they can provide technical advice at the local level. Given the retrenchment that has occurred in the public sector in The Gambia, it is not clear that adequate budgetary support is being provided to the Soil and Water Management Unit.

8. **The incentive to adopt a technology is not always market driven.** In The Gambia, rice is a preferred food that is produced primarily for home consumption rather than for sale. However, if the objective were to produce a marketable surplus of rice (or any other commodity, such as vegetables or livestock), a market in which to sell that surplus would be needed as an incentive to adopt the technology.

ANNEX A

Evaluation Methodology

A four person team carried out this assessment of the environmental impact of A.I.D. assistance to sustainable agriculture in The Gambia as well as a companion assessment of the environmental impact of A.I.D. assistance to forestry. The team was comprised of two economists (including one who focused on forestry), an agronomist, and a social scientist. The evaluation methodology used to carry out the two assessments was developed by the team during a three day team planning meeting in Washington, D.C. It is relatively straightforward, relying primarily on three main sources of information.

First, the team reviewed documentation available from the A.I.D. data base as well as from USAID/Banjul. Of particular importance were past evaluations of A.I.D.-supported activities as well as analytical work concerning the interface between environmental protection on the one hand and investments in agriculture and forestry on the other. The bibliography cites the main documents reviewed. Second, the team conducted key informant interviews with persons in The Gambia familiar with A.I.D.-supported activities in sustainable agriculture and forestry. These interviews were with key government officials as well as representatives from donor agencies and NGOs. Annex B lists the persons contacted in The Gambia. Third, the team visited various sites throughout the country where A.I.D.-supported activities had been implemented. Annex B lists each site visited, and the location of each site is shown in the Map of The Gambia (p. ix).

The team worked in The Gambia for about four weeks, from September 30 through October 28, 1993.

The evaluation methodology used a common analytical framework, one that had been used to undertake similar assessments in Pakistan, the Philippines, and Mali -- and which would be used for future assessments planned for other countries. This was to assure comparability among all the assessments. This common framework was organized around four strategies that typically had been used by A.I.D. to implement sustainable agriculture and forestry programs worldwide. The framework was designed not only to assess the long-term impact of A.I.D. programs (both biophysical impact and socio-economic impact) but also to understand what caused that impact in terms of one or more of the four strategies: technological change, awareness and education, institution building, and the policy environment. As such the four strategies served as the organizing principle for the survey instruments developed by the team.

The site visits were carried out over a six day period. In order to be able to visit the maximum number of sites within a given period of time, the team split into two groups, a sustainable agriculture group and a forestry group. In addition, a technical expert and a research assistant were recruited to assist each group and to serve as translators and enumerators. This allowed the sustainable agriculture group to visit 10 sites during the six days and the forestry group to visit 13 sites. Each site visit required approximately two and one-half hours. Exhibit I is the interview guide developed by the team to use for the key informant interviews conducted in Banjul. Exhibit II is the instrument used to provide a summary description of each site visited by the sustainable agriculture group. Exhibit III is the survey instrument used to gather data to assess biophysical impact. Exhibit IV is the survey instrument used to gather data to assess socio-economic impact.

These survey instruments were deliberately designed to be topical guides that would provide a structure in which to conduct the village interviews; they were not designed to elicit quantitative information that could subsequently be statistically analyzed across villages.

Exhibit I

Interview Guide

A. Background

A.I.D. is conducting a worldwide assessment of its environmental programs. The purpose is to assess the environmental impact of A.I.D.'s assistance in two areas: forestry and sustainable agriculture. We want to know what the impact of these programs has been; and we want to identify the strategies that appear to be most effective in different kinds of country situations.

So far we have conducted field studies in three countries: Pakistan, the Philippines, and Mali. The Gambia is the fourth country, and we expect to complete a fifth field study by the end of the year.

In each country we are looking at completed activities as opposed to on going activities. In The Gambia, we are looking primarily at four projects, two of which were completed in 1986: the Forestry Project, the Soil and Water Management Project, the Mixed Farming Project, and the GARD (Gambia Agricultural Research and Diversification) Project. One of these projects started in 1978, two started in 1979, and the GARD project started in 1986.

We are using the same evaluation framework for all of the country field studies. This is so we can synthesize the results and the lessons learned from all the country studies into one summary report on A.I.D.'s overall experience in forestry and another summary report on sustainable agriculture.

We want to understand which strategies work better and which strategies don't work so well under different country situations. We are especially interested in four strategies that the A.I.D. projects may have supported: first, support for the institutional framework within which the projects were implemented; second, promotion of environmental awareness and related educational programs; third, the development of environmentally sound agricultural technologies; and lastly, the support of economic and other policies (such as land tenure policies) to help assure a policy environment conducive to sustainable agricultural practices and forestry development.

B. Key Questions

1. What have been A.I.D.'s main contributions in these four areas or in other areas that you believe are important in promoting sustainable agriculture and forestry development?

2. What has been the impact of these activities? We are thinking here about biophysical changes that occurred as a result of the A.I.D. projects as well as social and economic benefits that may have accrued to farmers and others. We are also thinking about negative impacts as well as positive impacts.

3. What was the single most important factor that led to these changes; (or, what was the single most important constraint or problem that reduced the effectiveness of the projects)?

4. What other activities, beside activities supported by A.I.D., have been instrumental in promoting sound environmental practices in The Gambia?

5. What do think are the most important lessons learned since these projects were implemented?

6. What do think is the most important thing to do now to enhance The Gambia's environment in the forestry and sustainable agriculture areas?

Exhibit II
Site Description

Village Name:______________________ Size (people and dabadas):__________________ Date:__________

1. Site technical intervention:____

2. Who provided labor for intervention:____

3. Average site plot size (unit):__________ No. of plots:________ Total area (unit):________ Plots per person:________

4. Site's intervention status (well maintained, run down, etc.):____

5. Farming system (include principal crops, livestock and farming practices):____

6. Economic activities: proportion of dabadas which have the following (none, 1/10, 1/4, 1/2, 3/4, 9/10, all):

Swamp rice:__________ Vegetable plot sales:__________ Cattle:__________ Sales from fruit trees:__________

Other significant or unusual economic activities (activity and proportion):____

7. Land access (land tenure, fallowing practices and land availability and use):____

8. Biophysical features: Rainfall (mm/yr):______ Soil fertility (L,M,H):______ Soil texture:______________ Slope(%):_____

Soil permeability (L,M,H):_______ Soil erosion on fields (L,M,H):________ Gully erosion:(L,M,H):_________

Flooding (L,M,H):_______ Other features (describe on back):____

9. Labor needs in the farming system (General availability, gender allocation, peak demand times):____

10. Access to markets (Distance to nearest town or market, road condition, size of town or market):____

11. Extension access (Frequency of extension worker visits - other than SWMU staff, both before and after intervention; type of advice given, etc.):____

12. Other sources of extension information for farmers demonstrations, farmer-to-farmer contacts, visiting/observing other villages, publications, radio, schools, etc.):____

(If there are other characteristics of the site that make it unusual, these should be described on the reverse side of this sheet. For example: crop disease problems, very bad soils, village conflicts, unusually high labor out migration, etc.)

Exhibit III

Site Impact Assessment

Village Name:________________ Person(s) interviewed (status):________________

1. What was the situation before the intervention:________________

____

2. What is the situation now and the difference:________________

____

3. With the intervention, has there been a change in crop yields or range condition? (Specify which crops and get estimates of yields of each before and after - include units; For range probe for: more grass, longer grazing season, species improvement):________________

____

4. Did most people adopt the practices? (none, 1/10, 1/4, 1/2, 3/4, 9/10, all):________________

5. For farmers who adopted the intervention, was it adopted on most of their fields? (none, 1/10, 1/4, 1/2, 3/4, 9/10, all):___

____

6. What was the single most important thing that caused people to adopt the intervention?________________

____

7. If not adopted, what was the single most important reason for not adopting?________________

____

8. What has been the investment in building the intervention (labor, money, inputs)?________________

____

9. What are the maintenance requirements of the intervention and who does them?

____

10. Are there other non-farming benefits from the intervention (reduced flooding, higher water levels in wells, streams don't dry up, etc.)?________________

____

11. Are there other changes in farming that you have tried?________________

____

12. What worked best and what did you like the most about it?________________

____

13. Are there other changes in farming that you would like to try (After response, prompt if conservation practices aren't mentioned?________________

14. What prevents you (or the village) from trying other farming practices?________________

____

15. What is the overall environmental impact of the intervention (positive, negative, none, not sure)?________________

16. Why was there this impact?________________

____

17. Who are the main beneficiaries of improved conservation practices (men, women, farmers with access to inputs, farmers with draft animals, rich, poor, etc.)?________________

____

18. Thank the person/group.

Exhibit IV

Topical Guide: Social/Organizational Dimension

Village__________________Population_________Households_______Date____

I. Background [Ask informant to describe history of activity; dates; actors; process. Note public education, organizing, technical support, post-project support]

1) When did intervention begin? How did community first hear of intervention? Who were leaders? Which technical services involved?

2) Why was site selected, by whom? Who did land belong to? How was it being used? What is present use of land?

3) What services/NGOs were involved? How? What did they contribute? Still helping/present?

II. Participation [Who, when, what did they do, how was it organized. Community role]

1) Who worked? Frequency, tasks, for how long? Males, females, age, families, ward, other grouping

2) Was a group formed to organize work? Name, composition, role, current status

3) Did community meet to decide on activity? Role in design, implementation, management

III. Evaluation of Success/Failure [Overall, and then by components, reasons for success/failure, unanticipated benefits/costs]

1) Was activity successful? Why or why not? What was Single most important reason for success/failure?

2) Why were people willing (incentives) or unwilling (disincentives) to continue activity? Profit, access to markets/inputs, insecure tenure, technical problem/failure

3) Did other good/bad things happen because of activity that were not expected?

IV. Socio-economic Impact [Who benefitted, nature of benefits, value/amount, relation between participation and benefits; who lost, nature of loss, etc.]

1) Who benefitted the most? By sex, caste, landholding status, old families or recent immigrants; order (1,2,3)

2) How did they benefit? Money, food security, time saved, labor, prestige, productivity. [Quantify] How was money/crops used?

3) Who lost? Sex, caste/class, ethnicity, etc. How/what did they lose?

4) Did those who worked most, benefit most? Why/why not?

5) Did the community as a whole benefit? How?

V. Sustainability/Replicability [Maintenance (MT) system and status of MT, priority for users, continuity of benefits, spread to other communities]

1) How is activity (infrastructure) to be maintained? Who, organization, frequency, cost

2) Is activity/infrastructure well maintained now? Why/why not?

3) Have others (individuals, villages) asked about activity? Requested assistance? Done it themselves? Who, where, when, status

VI. Remaining concerns/issues

THANKS TO ALL INFORMANTS

NATURAL RESOURCE MANAGEMENT AGREEMENT

BETWEEN

SAVE THE CHILDREN/USA

AND

THE COMMUNITY OF BAKINDIK

APRIL, 1993

3

ABSTRACT

This agreement, drawn between Save the Children/USA and the community of Bakindik, will guide the implementing of the following ANR interventions:

1. construction of anti-salt dikes and training in agronomic practices to reduce salinity and toxicity problems in the "KANYA KUTA" valley

2. conservation activities in the upland areas of Bakindik to enhance soil fertility

BACKGROUND

The Participatory Rapid Appraisal (PRA) conducted in January, 1993, was a first step towards developing a Natural Resource Management program in Bakindik. Although four other villages farm the valley and participated in the PRA, this agreement is primarily with Bakindik, the traditional owner of the valley. The project will be jointly implemented by Save the Children/USA (SCF), the Soil and Water Management Unit (SWMU), and the Bakindik community.

The PRA identified the community's priorities as:

1) combatting the problems of salt intrusion and land reclamation in the "KANYA KUTA" valley; and

2) soil conservation in the Bakindik upland fields.

This agreement aims to clarify the roles and responsibilities of either party. To the credit of Bakindik and neighbouring communities - Medina Sedia, Nema Kunku, Barkalarr, and Mademba Kunda - and their enthusiasm to improve their environment, some of the activities described below have been accomplished or are in progress. Where this is so the activity is marked either [DONE] or [In Progress].

THE NATURAL RESOURCE MANAGEMENT AGREEMENT

Save the Children/USA and the community of Bakindik for a period of five years beginning January 1993, agree to the following:

KANYA KUTA Valley - The Lowland

To construct anti-salt dikes and carry out recommended agronomic practices, Save the Children/USA will provide the following services and materials at no cost to the community:

1. Contract SWMU to conduct a detailed implementation survey to determine placement of dikes and measure the pit level of the soil. [DONE]

2. Share the information obtained from the survey and discuss implementation schedule with the community. [DONE]

3. Provide technical expertise during dike construction. [In Progress]

4. Provide supplementary materials like spades, wheel-barrows, and head pans to facilitate dike construction. All materials will be returned to Save the Children/USA at the end of their project use. [In Progress]

5. Provide mechanical equipment where necessary including:
   - heavy duty tractor to loosen the top soil during dike construction; [In Progress]
   - tractor to facilitate transportation of sand and gravel;
   - tractor to prepare land for liming.

6. Provide construction materials - cement, rods, and BRC for building spill ways.

7. Provide lime in the first year (1993) to women whose fields are affected by acidity and train them on its application.

8. Assess and provide available rice varieties on loan that can perform better under the current ecological conditions.

9. Conduct technical rice production training to enable women to adopt recommended techniques for increased production.

10. Along with SWMU, train selected villagers on maintenance techniquess and spillway operation, monitor the performance/maintenance of the dikes and spillways and make appropriate recommendations to the VDC.

11. Collect data on the effect of interventions in the rice fields including:

    - yields
    - varieties
    - practices adopted
    - soil salinity and toxicity
    - overall hectarage reclaimed

    These data will be collected over the 5 year span of the project.

The Bakindik Community will be responsible for the following during and after project implementation:

1. Mobilize unskilled labour for dike construction [In Progress]

2. Provide land for dike construction and allow land preparation in acidic areas. [In Progress]

3. Handle any land disputes in a quick and just manner.

4. Safely keep all materials and tools provided to the project and return all to Save the Children/USA at the end of their project use. (spades, wheelbarrows, head pans).

5. Ensure mechanical equipment is used for carrying out only the agreed functions.

6. Participate in technical training on liming, rice technology, dike maintenance and spillway operation, and ensure adoption of recommended practices.

7. Select 5 persons in every community for training on spillway operation to be in charge of inspecting the spillways after every heavy rain to regulate water level in the fields.

8. To those fields affected by acidity, provide lime in the second (1994), third (1995), Fourth (1996) and fifth (1997) years as needed, under supervision of the VDC.

9. Repay seed/fertilizer loan at the end of harvest.

10. Avail information that may be necessary in the monitoring and evaluation of the program.

The Upland

In order to increase soil fertility and reduce the effect of erosion and sedementation in the Bakindik watershed, Save the Children/USA will provide the following services and materials:

1. Contract SWMU to mark and supervise construction of water diversion bunds to divert runoff water towards the valley.

2. Provide vetiver grass for hedgerow establishment and bund stabilization.

3. Provide polypots, some tree seeds, and advise on establishment of a village nursery.

4. Conduct technical trainings on vetiver planting and care, and bund maintenance.

5. Gather information on the effect of intervention in the upland including:

   . bund effectiveness
   . hedgerow development
   . maintenance
   . yields
   . adoption of recommended practices

These data will be collected over the 5 year project span.

The Bakindik Community will be responsible for the following:

1. Provide unskilled labour.

2. Provide land for bunds to pass through.

3. Handle any land disputes quickly and judiciously.

4. Plant and maintain vetiver hedgerows along the bunds. Planting may begin in July of 1993 after the soil has retained some moisture and villagers are free to plant grass. A small trench will be placed on the up slope side of the bunds and slips of grass planted 10-15 cm apart. Each farmer will be responsible to replace any slips that die and trim the grass to allow rapid closure of the hedgerow.

5. Repair and maintenance of bunds.

6. Management of a village tree nursery to propagate tree seedlings to be planted in and around the village. A minimum of 5,000 trees will be out-planted each year. At the end of the 5th year, the community may petition additional support from Save the Children/USA or sustain the effort themselves.

7. Protect trees from animals and bush fires, which includes building and maintaining structures around each tree until the tree is safe from grazing and clear grass away, for at least a 1 meter radius, from each tree at all times to protect against fire. Failure to protect the trees adequately may result in the withdrawal of support by Save the Children/USA of the village nursery.

8. Avail information that may be necessary in the monitoring and evaluation of the program.

Save the Children/USA and the Bakindik Community enter into this agreement in good faith and will hold periodic meetings to assess progress of this initiative and take corrective measures necessary in the pursuance and achievement of its major goal of enhancing the natural resource management practices in Bakindik.

This agreement is valid from January 1993 - December 1997 and will be renewed and amended appropriately as necessary.

Failure by either party to honor their commitment may lead to suspension of the agreement by the wronged party.

Signed: ______________________
Alkalo
Date:

Signed: ______________________, Program Manager
Save the Children/USA
Date: 6th August, 1993

Signed: Bakary Faye
VDC Chairman
Date: 6/8/93

Signed: Aja Awa Sonko
Women's Group Leader
Date: 6/8/93

Witness
Signed: ______________________
Chief Lower Baddibu
Date: 15/8/93 Niumi

Witness
Signed: ______________________
Commissioner, North Bank Division
Date:

Witness
Signed: ______________________
Forestry Officer, NBD
Date:

ANNEX C

Persons Contacted and Sites Visited

A. Persons Contacted

Government of The Gambia

Yaya Jallow
Permanent Secretary
Ministry of Agriculture

Ousman Jammeh
Deputy Permanent Secretary
Ministry of Agriculture

John Fye
Head
Soil and Water Management Unit
Ministry of Agriculture

Kabir Sonko
Agronomist
Soil and Water Management Unit
Ministry of Agriculture

Musa Mbenga
Assistant Director
Department of Agricultural Research
Ministry of Agriculture

Musa Suso
Department of Agricultural Research
Ministry of Agriculture

Ken John
Director
Department of Planning
Ministry of Agriculture

Omar Touray
Director
Department of Livestock Services
Ministry of Agriculture

Amadou Taal
Permanent Secretary
Ministry of Local Government and Lands

Sehou Jobe
Ministry of Finance

USAID/Banjul

Bonnie Pounds
Director

Gary Cohen
Agriculture Development Officer

Omar Jallow
Project Management Specialist

NGOs and Other Donors

Diane Nell
Director
Save the Children/USA

Turi van Zuten
Action Aid

Solomon Owens
Project Director
CRS

Dominique Reeb
German Team Leader
Gambian-German Forest Project

Ted Wittenberger
Assistant Director
Peace Corps

Mr. Paterson
FAO

Consultants

Asif Sheikh
President
International Resources Group (IRG)

Amare Getahun
Chief of Party
USAID ANR Project

Frank W. Kooistra
Budget Specialist
Ministry of Finance

Isatou Sawaneh
Consultant

Ben Carr
Consultant

B. Sites Visited

Kembujeh
Bakindik
Jufureh
Njawara
Sera-ngai
Sapu
Dankunku
Kwinella
Tendaba
Sintet

(See p. ix, Map of The Gambia, for the specific locations of these sites visited by the evaluation team.)

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